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WEATHER NOTE

Minimal Tropical Depression Produces Record Rains and Unprecedented Floods

D. R. DAVIS—*National Weather Service, NOAA, Quincy, Fla.*

W. C. BRIDGES—*Water Resources Division, U.S. Geological Survey, Tallahassee, Fla.*

ABSTRACT—A weak tropical depression moved out of the Gulf of Mexico on Sept. 19–20, 1969. With the blocking action of a surface High and in the absence of steering currents aloft, the Low became stationary on the Florida coast for approximately 48 hr. Torrential rains occurred in a small area 60–65 mi to the east and 50 mi inland from the point where the Low made landfall. Record-breaking floods resulted. The 23-in. maximum point rainfall was about 9 in. greater than the previous maximum rainfall of record produced by a 1924 tropical storm in the same area. The location of the area of maximum rainfall with respect to the point of landfall of the Low's center closely follows the pattern previously reported for the more intense hurricanes and tropical storms.

1. INTRODUCTION

On Sept. 20–23, 1969, a small tropical Low caused heavy rains in parts of the Florida Panhandle and extreme southern Georgia with a maximum in excess of 23 in. over an area 20 mi northwest of Tallahassee, Fla. Heavy flooding occurred along the Little River in Gadsden County, Fla., and in that portion of the Oclockonee River Basin that is in Gadsden, Leon, Liberty, and Wakulla Counties, Fla.

No loss of life resulted from the flooding although agricultural and property damages were extensive. One of the more important aspects of this flood was the number of road closures and the resulting inconvenience to the commuting public. There were 51 points, most of which were in Gadsden County, where roads were closed because of flooding and flood damage to roads, bridges, and culverts.

The synoptic situation, radar observations, rainfall, and peak stream discharges associated with this tropical Low and the similarity of this Low to a tropical storm that hit the same area in 1924 are briefly reviewed in this paper. For a comprehensive survey of the meteorological and hydrological aspects of this storm see Davis and Bridges (1971).

2. SYNOPTIC SITUATION

The system first became evident on the surface weather analysis chart late on September 19, when a ship report indicated the presence of a low-pressure area approximately 300 mi west-northwest of Key West, Fla. The surface weather analysis at 0100 EST on September 20 revealed a Low with a closed isobar having a central pressure of 29.70 in. centered at 25.0°N, 88.4°W. This Low moved northward during the day, reaching land between Panama City and Port St. Joe, Fla., by 0400 EST on September 21. The Low moved into the dissipating trough of a stationary front along the northern gulf coast (fig. 1). A large surface High, covering most of the eastern half of the United States, acted as a block to the Low. The 500-mb chart (fig. 2) for 0700 EST showed a weak closed circulation aloft. With blocking action at the surface and no distinct steering current, the Low stalled shortly after reaching the coast and remained practically stationary for approximately 48 hr.

Heavy rain fell on the Little and Ochlockonee River Basins and on the Lower Apalachicola River Basin during the time the Low was stationary. Map analyses indicated alternate periods of filling and deepening of the system, reflected in the fitful character of the rainfall. By September 23, the high-pressure system along the eastern seaboard weakened, and the low-pressure area filled until it was discernible only as a weak inverted trough.

3. RADAR

The precipitation area associated with this tropical Low was under constant surveillance by the National Weather Service radar at Apalachicola, Fla. A large rain area offshore was detected by the radar late on September 19 and early on the 20th. The rain moved northward to the coast by 0100 EST on the 20th. As the rain area moved northward, there was evidence of strong cells organizing into lines or bands. Individual cells appeared to move north to northwest along the band while the whole precipitation area drifted slowly northward.

Light to moderate rain began at Havana, Fla., the area that received the greatest storm rainfall, in the early morning of September 20 with heavy rain beginning about 1400 EST. Moderate to heavy precipitation fell over most of the Lower Apalachicola, Little, and Ochlockonee River Basins during most of the day on the 20th.

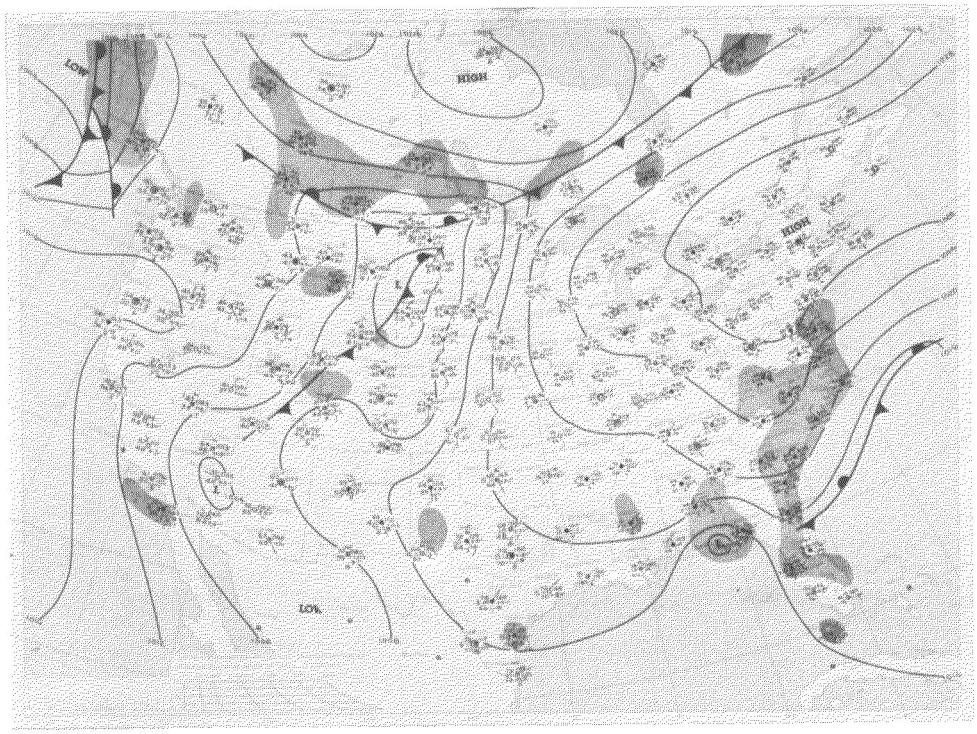

FIGURE 1.—Surface analysis for 0700 EST on Sept. 21, 1969 (Daily Weather Maps, weekly series Sept. 15–21, 1969, U.S. Department of Commerce, ESSA, Environmental Data Service).

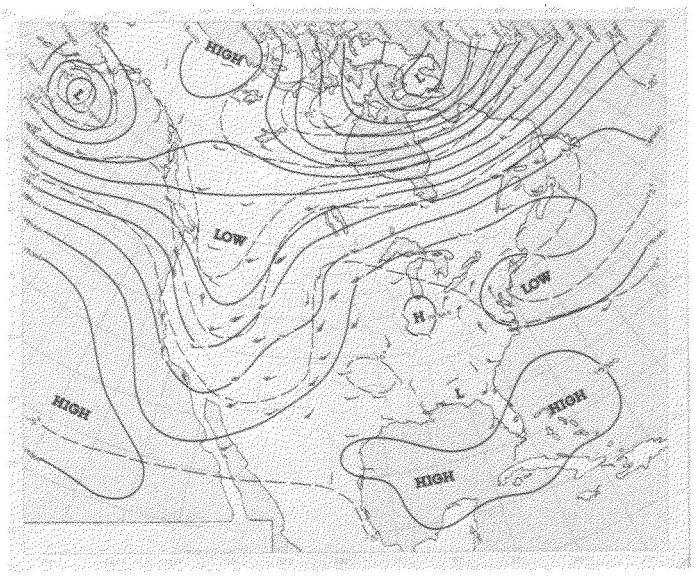

FIGURE 2.—The 500-mb analysis (height in ft) for 0700 EST on Sept. 21, 1969 (Daily Weather Maps, weekly series Sept. 15–21, 1969, U.S. Department of Commerce, ESSA, Environmental Data Service).

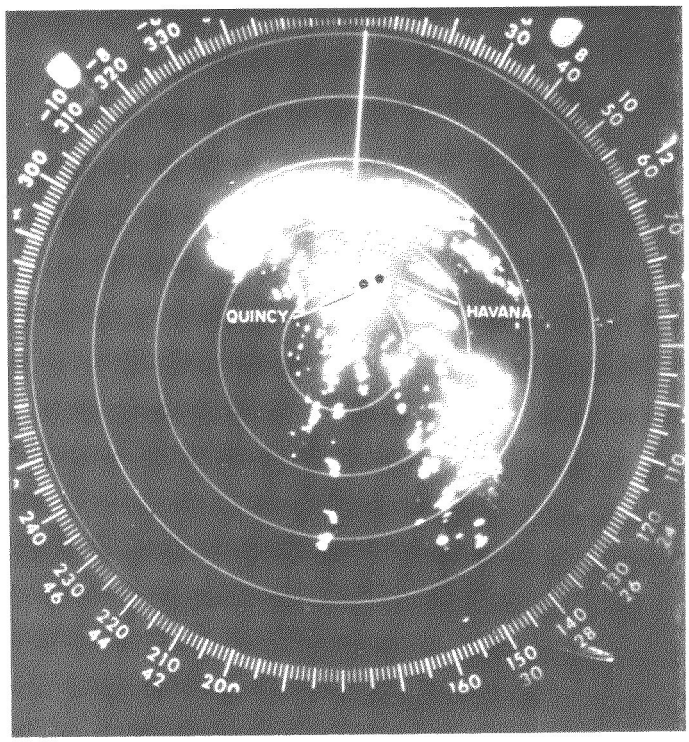

FIGURE 3.—Photograph of the Apalachicola, Fla., radar scope at 0639 EST on Sept. 21, 1969. Rainfall intensity at this time was in excess of 6 in./hr at Quincy. The range setting is 250 n.mi. and range markers are at 50-n.mi. intervals with no attenuation. Antenna elevation angle is 0.5°.

After the Low reached the coast on the morning of September 21, radar pictures indicated a tendency for the precipitation to be oriented in northwest–southeast to north–south lines with the heaviest precipitation area essentially stationary over Gadsden and neighboring counties of Florida and south Georgia. Individual cells moved northward along the lines, converging on this area, while the lines moved little. At times, two or three lines appeared to radiate out of a point centered over, or near, a small area in northern Gadsden County, Fla., and the south parts of Grady and Decatur Counties in Georgia.

Figure 3 shows the precipitation pattern at 0639 EST on September 21, shortly after the start of extremely

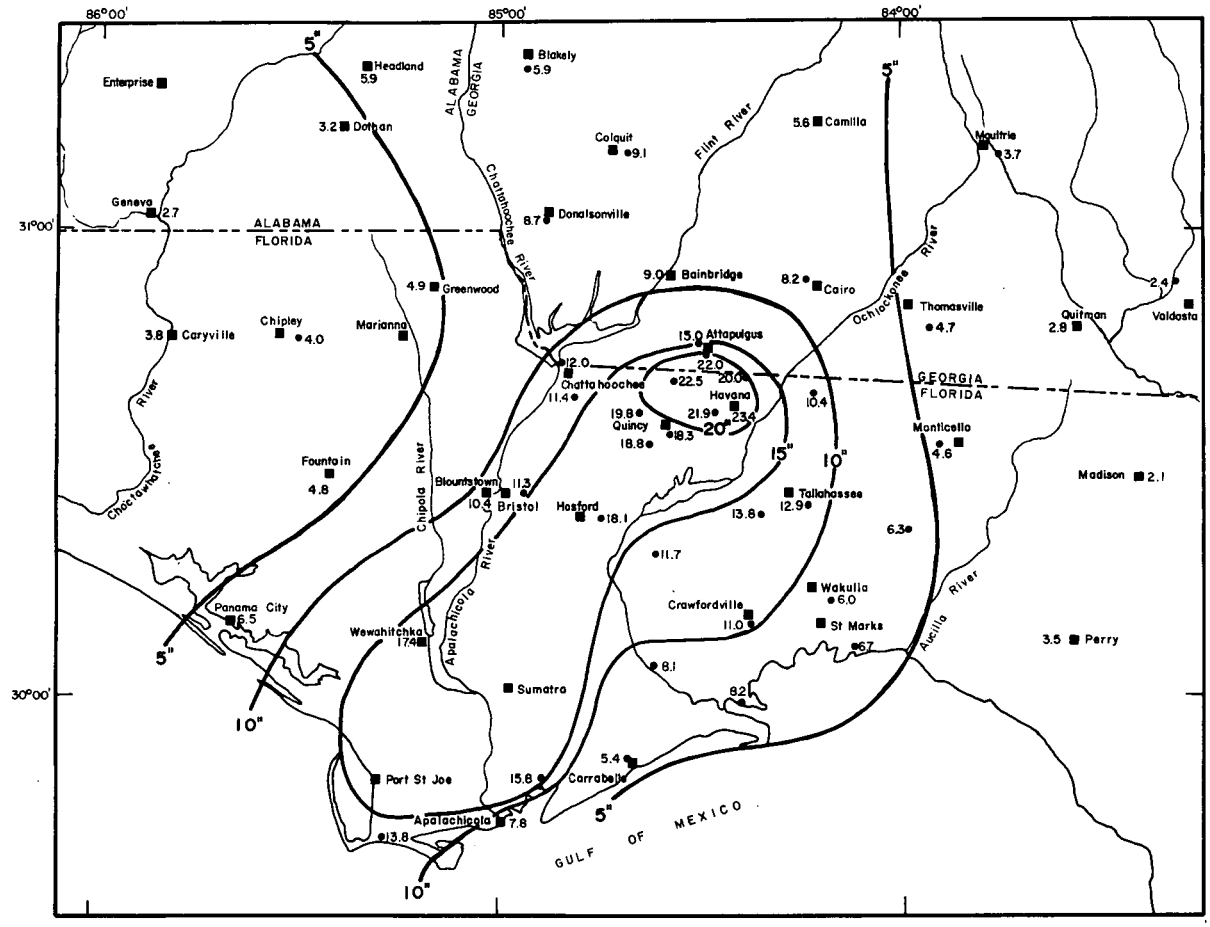

FIGURE 4.—Total storm rainfall map for Sept. 20–23, 1969. The numbers indicate the rainfall to the nearest 0.1 in.

heavy precipitation at Quincy, Fla. Records from recording rain gages showed that this precipitation continued for nearly 3 hr and that, at the time of the photograph, the rainfall rate at Quincy was in excess of 6 in./hr.

Throughout the night of September 21, and during the morning of the 22d, precipitation bands continued to converge on the Quincy-Havana area with individual cells in the bands moving northward and becoming stationary. The lines slowly disintegrated into disorganized cells during the afternoon of the 22d only to regroup into well-defined lines after 1730 EST. In the early morning hours of the 23d, the precipitation area began to show signs of an eastward movement, and by 0900 EST, the lines broke into individual cells that moved rapidly away to the east and northeast.

4. PRECIPITATION

The isohyetal map for September 20–23 is shown in figure 4. The maximum point-rainfall of 23.40 in. was measured near the western edge of Havana, Fla. The 20-in. isohyet enclosed an area of approximately 160 mi^2 in which the average precipitation was about 22.0 in. The 15-in. isohyet enclosed an area of approximately 2,000 mi^2. The average rainfall amount at all the gages within the 15-in. isohyet was 19.8 in.

There were no recording gages within the area represented by the 20-in. isohyet. Radar analysis indicated that rainfall intensities, as recorded at Quincy, 12 mi west of Havana, were probably representative of intensities within the area of maximum precipitation. Rainfall intensities for the Quincy gage are shown in table 1. The intensities for 2, 6, 12, 24, 48, and 72 hr and the storm total exceeded the probability of 1 in 100 yr (Hershfield 1961, Miller 1964).

The maximum 6-hr point rainfall occurred between 2 and 8 hr after the Low center reached land on the morning of September 21. The center of maximum storm precipitation was 60–65 mi to the right of the point of landfall and some 50 mi inland. The time of the heaviest precipitation and the location of maximum precipitation in this minimal tropical depression were similar, with respect to time and point of landfall of storm center, to those for hurricanes and tropical storms reported by Goodyear (1968).

5. FLOOD AND PEAK DISCHARGE

Runoff from the excessive precipitation caused streams to rise to record levels. Peak discharge measurements at many of the gaging points far exceeded the discharges having a 50-yr recurrence interval. The peak discharge of the Little River near Quincy was 45,600 ft^3/s on September 22; previously, the maximum recorded since 1950

TABLE 1.—*Maximum precipitation intensities at Quincy, Fla., for Sept. 20–23, 1969*

Rainfall duration	Rainfall	Rainfall duration	Rainfall
(min)	(in.)	(hr)	(in.)
5	0. 62	2	6. 23
10	1. 17	3	7. 90
15	1. 61	6	10. 87
20	1. 98	12	12. 07
30	2. 50	24	15. 06
45	3. 24	48	17. 71
60	3. 76	72	18. 84

Storm total 18.85 in.
Storm duration 72 hr, 16 min
Rain began 0410 EST on September 20
Rain ended 0426 EST on September 23

was 25,400 ft^3/s. The peak discharge of 89,400 ft^3/s for the Ochlockonee River near Bloxham, Fla. was 1.8 times the previous recorded maximum of 50,200 ft^3/s. Record peak discharges were measured at eight other gaging stations. A maximum runoff of 1,270 $ft^3 \cdot s^{-1} \cdot mi^{-2}$ was measured on a 1.3-mi^2 area on Midway Branch near Midway, Fla. For a detailed description of the flood see Bridges and Davis (1972).

6. COMPARISON WITH A 1924 STORM

The previous record rainfall for the area occurred on Sept. 14–15, 1924. (U.S. Department of Commerce 1924). This rainfall was associated with a tropical storm of near-hurricane strength that dumped up to 13 in. of rain on Gadsden County in a 24-hr period.

The 1924 and 1969 tropical cyclones made landfall at about the same point on the coast and both were small in diameter. High barometric pressure was reported to the north and east of the 1924 tropical storm, as was the case in 1969. Unlike the 1969 Low, however, the 1924 storm did not become stationary. Total precipitation for the center of maximum rainfall in 1924 was approximately 9 in. less than in 1969, but the rain was concentrated over very nearly the same area.

The storm of September 1969 was one of the weak tropical cyclones that move out of the Gulf of Mexico from time to time. They may make landfall at almost any point on the gulf, producing heavy rain and local flooding. While the areal extent of excessive rainfall associated with the weaker tropical cyclones is small in comparison to that of hurricanes or tropical storms, the frequency of occurrence of these minimal tropical systems, as well as the amount of local flooding they are capable of producing, makes them significant storms throughout the gulf area.

REFERENCES

Bridges, W. C., and Davis, D. R., "Floods of September 20–23, 1969, in the Gadsden County Area, Florida, " *Bureau of Geology Information Circular* 79, Florida Department of Natural Resources, Tallahassee, Fla., **1972**, (in press).

Davis, D. R., and Bridges, W. C., "A Blocked Minimal Tropical Depression Becomes a Storm of Rare Occurrence," *NOAA Technical Memorandum* NWS SR–59, U.S. Department of Commerce, National Weather Service, Southern Region Headquarters, Fort Worth, Tex., Oct. **1971**, 18 pp.

Goodyear, Hugo V., "Frequency and Areal Distributions of Tropical Storm Rainfall in the United States Coastal Region on the Gulf of Mexico," *ESSA Technical Report* WB–7, U.S. Department of Commerce, Weather Bureau, Silver Spring, Md., July **1968**, 33 pp.

Hershfield, David M., "Rainfall Frequency Atlas of the United States for Durations From 30 Minutes to 24 Hours and Return Periods From 1 to 100 Years," *Technical Paper* No. 40, U.S. Department of Commerce, Weather Bureau, Washington, D.C., May **1961**, 115 pp.

Miller, John F., "Two- to Ten-Day Precipitation for Return Periods of 2 to 100 Years in the Contiguous United States," *Technical Paper* No. 49, U.S. Department of Commerce, Weather Bureau, Washington, D.C., **1964**, 29 pp.

U.S. Department of Commerce, Weather Bureau, *Climatological Data, Florida*, Vol. 28, No. 9, Washington, D.C., Sept. **1924**, pp. 35–39.

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